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Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):
Dey, R. S., & Chi, Q. (2014). *Three-Dimensional Reduced Graphene Oxide Network on Copper Foam as High-performance Supercapacitor Electrodes*. Abstract from 65th Annual Meeting of the International Society of Electrochemistry, Lausanne, Switzerland.

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Three-Dimensional Reduced Graphene Oxide Network on Copper Foam as High-performance Supercapacitor Electrodes

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Electrochemically generated copper foam (Cuf) could serve as an effective template for fabrication of three-dimensional (3D) reduced graphene oxide (rGO) networks. Here we present a facile approach to preparation of 3D rGO network supported by Cuf as binder-free and current collector-integrated supercapacitor electrodes (3DrGO@Cuf) [1]. The method involves a two-step procedure, self-assembly of graphene oxide (GO) nanosheets on Cuf and electrochemical reduction of GO into rGO. We have systematically characterized as-synthesized materials using AFM, SEM and XRD to reveal their morphological and structural features. Electrochemical functional tests show that such electrodes are capable of delivering a specific capacitance as high as 623 F g^{-1} at a current density of 1 A g^{-1}. The observed high specific capacitance is most likely attributed to the unique porous structure consisting of highly connected nanoscale pores and high-density capacitive sites. 3DrGO@Cuf electrodes also exhibit considerably high stability over successive charge-discharge switching. For example, over 98 % specific capacitance is retained after 2000 cycles. To the best of our knowledge, we may have achieved the highest specific capacitance with 3DrGO@Cuf electrodes among reported pure 3D graphene materials to date (i.e. 3D graphene materials without doping additional capacitive species) [2, 3].

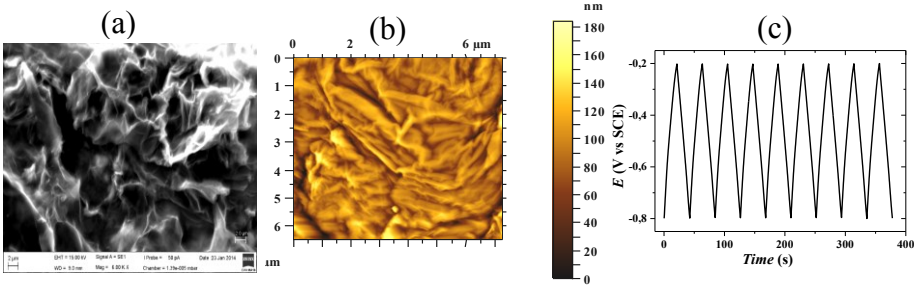

Fig. 1. (a) SEM and (b) AFM image of 3DrGO nanostructures on Cu foam. (c) Charge-discharge profile of 3DrGO@Cuf in 1M PBS (current density: 10 A g^{-1}).

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Acknowledgements
This work was supported by the Danish Research for Technology and Product Science (Project No. 12-127447). R.S.D. acknowledges a Hans C. Ørsted Postdoc Fellowship honored by Technical University of Denmark.

ise140688